shows a first layer of metal (M1). FIG. 46 shows connections including 4601 and 4602. FIG. 47 shows a second metal layer (M2). Connections 4601 and 4602 connect the M1 and M2 layers to form a yVcom line as shown in the figures. FIGS. 48-50 show a connection layer, a reflector layer, and an ITO layer, respectively. FIG. 51 shows a completed pixel including a yVcom portion that allows connection in the y-direction. FIG. 52 shows a side view of pixel 5101 along the line shown in the top view shown in FIG. 52. FIG. 53 shows a calculation of the storage capacitance of pixel 5101. FIG. 54 shows an aperture ratio estimation of pixel 5101 and a pixel 5403 that does not include a yVcom line. FIG. 55 shows that some metal, such portions of the M1, M2, and/or ITO layers can be shifted to help equalize the aperture ratios of the pixels.

[0162] FIG. 56 illustrates a portion of an example touch screen 5600 that includes a grounded separator region according to embodiments of the invention. Similar to some embodiments described above, touch screen 5600 includes regions for driving (5601 and 5602) and regions for sensing (5603 and 5604). The drive regions are connected to drive lines 5611 and 5612, and the sense regions are connected to sense lines 5613 and 5614. Touch screen also includes a grounded separator region 5605, which is a region of pixels having linked-together storage capacitors, as described above, that is grounded. Grounded separator region 5605 can help to electrically isolate touch pixel areas and may improve the detection of touch by touch screen 5600. Grounded separator regions can be, for example, evenly spaced throughout a touch screen.

[0163] FIG. 57 is a side view along the line A-A in FIG. 56, showing the portion of touch screen 5600, including a cover 5701, an adhesive 5702, a polarizer 5703, a high resistance (R) shield 5704, a color filter glass 5705, drive regions 5601 and 5602, sense regions 5603 and 5604, grounded separator region 5605, a TFT glass 5706, and a second polarizer 5707. A high resistance shield, such as high R shield 5704, may be used in touch screens using IPS LCD pixels, for example. A high R shield may help block low frequency/DC voltages near the display from disturbing the operation of the display. At the same time, a high R shield can allow high-frequency signals, such as those typically used for capacitive touch sensing, to penetrate the shield. Therefore, a high R shield may help shield the display while still allowing the display to sense touch events. High R shields may be made of, for example, a very high resistance organic material, carbon nanotubes, etc. and may have a resistance in the range of 100 Mega-ohms per square to 10 Giga-ohms per square.

[0164] FIG. 58 shows a side view of a portion of an example touch screen 5800 according to embodiments of the invention. Touch screen 5800 includes a color filter glass 5801, a pixel layer 5803 (including red (R), green (G), and blue (B) pixels, and black mask lines of a black mask, such as shown in FIG. 59). Touch screen 5800 also includes metal lines 5805 under the black mask lines. Metal lines 5805 can provide low-resistance paths, for example, between a region of pixels and bus lines in the border of a touch screen. For example, in conventional LCD non-IPS displays, the common electrode, which is typically on the CF glass, is one sheet of ITO. Therefore, the resistance of this common electrode is very low. For example, a conventional LCD may have a common electrode of ITO that has a resistance of approximately 100 ohms per square. However, in some embodiments above the common electrode is "broken up" into regions that are connected to a shared common line through relatively thin pathways. The connection between a region of pixels and a shared common electrode line can have a relatively high resistance, particularly if the region is further away from the boarder of the touch screen, in which the shared common line may reside. Metal lines 5805 may help lower the resistance of the path to such a region. Placing metal lines 5805 under the black mask can reduce the metal lines' impact on pixel aperture ratio, for example.

[0165] FIG. 59 shows an example black mask layout according to embodiments of the invention. Black mask 5901 shields a yVcom line and a color data line. Mask 5901 can help to reduce potential LCD artifacts between different regions. Mask 5902 shields a color data line. Mask 5901, which covers two lines, is wider than mask 5902.

[0166] FIG. 60 shows an example IPS-based touch-sensing display in which the pixel regions serve multiple functions. For example, a pixel region can operate as a drive region at one time, and operate as a sensing region at another time. FIG. 60 shows two type of pixel regions, pixel region type A and pixel region type B. During a first time period the A type pixel regions, i.e., touch columns, can be driven with a stimulus waveform while the capacitance at each of the B type pixel regions, i.e., touch rows, can be sensed. During a next time period, the B type pixel regions, i.e., touch rows, can be driven with a stimulus waveform while the capacitance at each of the A type pixel regions, i.e., touch columns, can be sensed. This process can then repeat. The two touch-sense periods can be about 2 ms. The stimulus waveform can take a variety of forms. In some embodiments it may be a sine wave of about 5V peak-to-peak with zero DC offset. Other time periods and waveforms may also be used.

[0167] FIG. 61 illustrates an example computing system 6100 that can include one or more of the embodiments of the invention described above. Computing system 6100 can include one or more panel processors 6102 and peripherals 6104, and panel subsystem 6106. Peripherals 6104 can include, but are not limited to, random access memory (RAM) or other types of memory or storage, watchdog timers and the like. Panel subsystem 6106 can include, but is not limited to, one or more sense channels 6108, channel scan logic 6110 and driver logic 6114. Channel scan logic 6110 can access RAM 6112, autonomously read data from the sense channels and provide control for the sense channels. In addition, channel scan logic 6110 can control driver logic 6114 to generate stimulation signals 6116 at various frequencies and phases that can be selectively applied to drive lines of touch screen 6124. In some embodiments, panel subsystem 6106, panel processor 6102 and peripherals 6104 can be integrated into a single application specific integrated circuit (ASIC).

[0168] Touch screen 6124 can include a capacitive sensing medium having a plurality of drive regions and a plurality of sense regions according to embodiments of the invention. Each intersection of drive and sense regions can represent a capacitive sensing node and can be viewed as picture element (pixel) 6126, which can be particularly useful when touch screen 6124 is viewed as capturing an "image" of touch. (In other words, after panel subsystem 6106 has determined whether a touch event has been detected at each touch sensor in the touch screen, the pattern of touch sensors in the multi-touch panel at which a touch event occurred can be viewed as an "image" of touch (e.g. a pattern of fingers touching the panel).) Each sense region of touch screen 6124 can drive